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# STAFF REPORT

Pesticide Use in United States  
Citrus Production, 1977

by

John J. Haydu

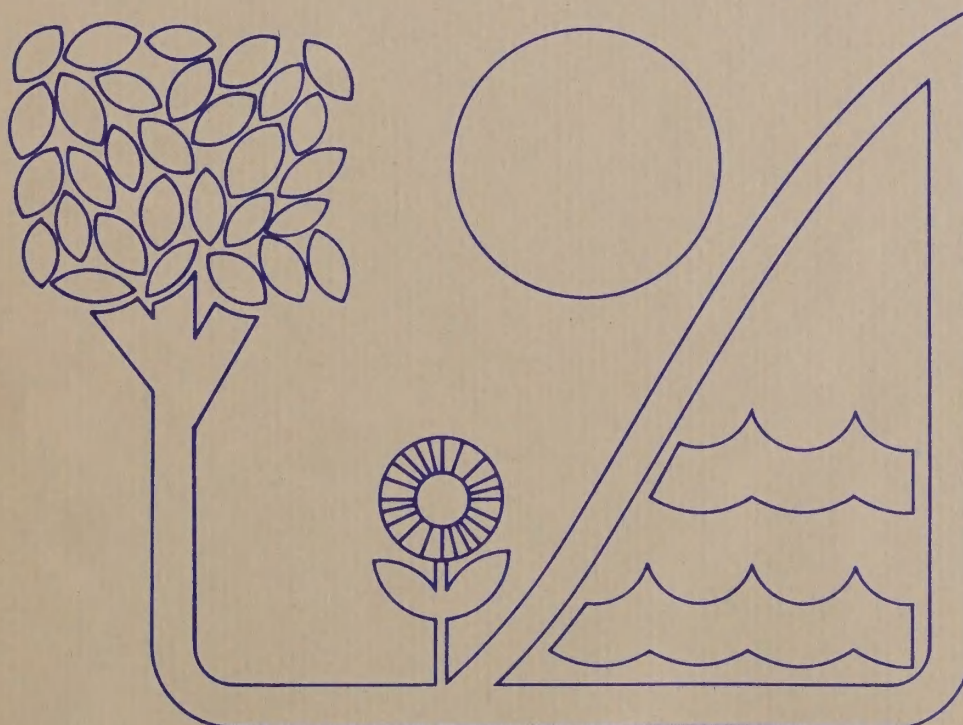
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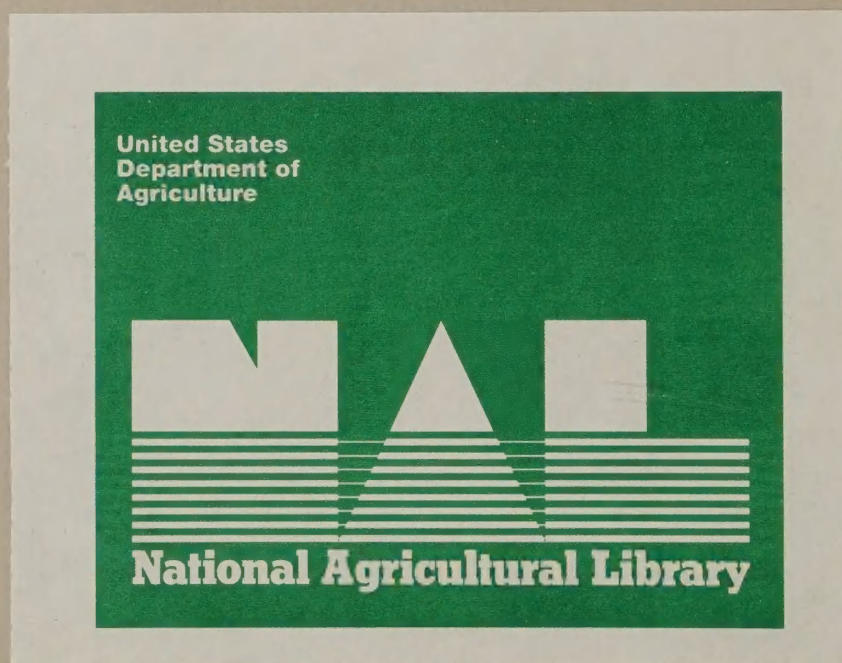
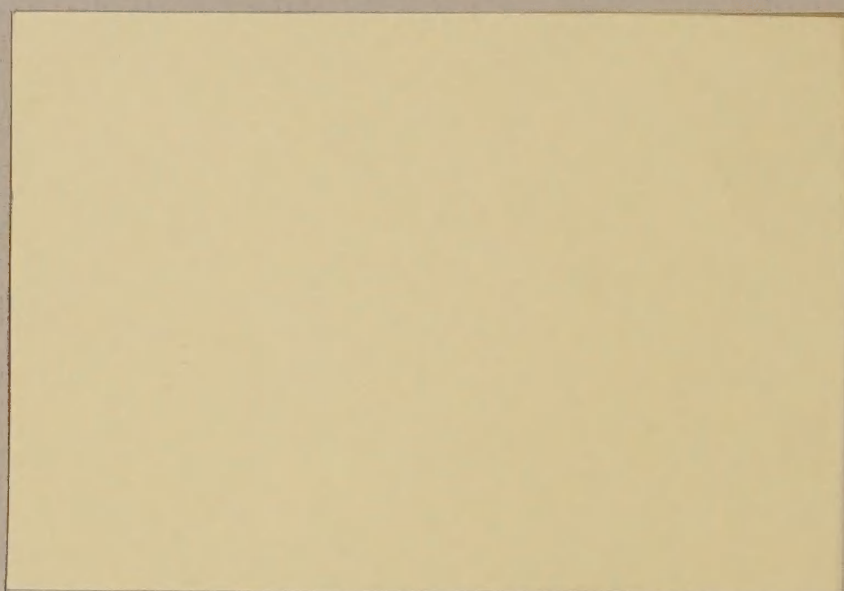
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Abstract

Abstract: The citrus production for 1977 was estimated for the three citrus producing regions in the United States (Florida, Texas, and California/Arizona). Citrus groves used an estimated 28.4 million pounds of active ingredients in approximately 5.2 million acre-inches during 1977. Of this the South, Southwest, and Northwest regions accounted for 5.2 million pounds, 10.4 million pounds, and 12.8 million pounds, respectively. Florida citrus groves used the largest amount of pesticides for citrus production, with 12.8 million pounds of active ingredients.

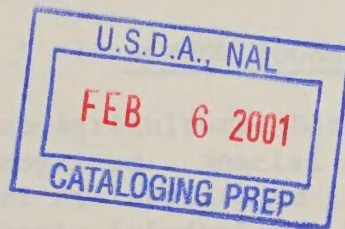
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United States Department of Agriculture  
Economics and Statistics Service  
Natural Resources Economics Division  
Washington, D.C. 20250



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### ABSTRACT

Pesticide use in citrus production for 1977 was estimated for the three citrus producing regions in the United States (Florida, Texas, and California/Arizona). Citrus growers used an estimated 38.4 million pounds of active ingredient in approximately 8.2 million acre-treatments during 1977. Of this U.S. total, fungicides accounted for 5.2 million pounds, insecticides 27.8 million pounds, and herbicides 5.5 million pounds. Florida citrus growers used the largest amount of pesticides for citrus production with 32.5 million pounds followed by California/Arizona with 4.2 million pounds and Texas with 1.9 million pounds.

Key words: Pesticides; fungicides; insecticides; herbicides; citrus 1977; method of application.

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## Introduction

The purpose of this survey is to estimate pesticide use in citrus production. Attention centers on fungicides, insecticides and herbicides because they comprise a majority of pesticides used on citrus. Application methods were surveyed, specifically focusing on whether the pesticides were applied by the grower or custom applicator and whether the pesticides were applied by aerial, ground, band, broadcast or irrigation methods.

Florida, Texas and California/Arizona constitute the three citrus producing regions in the United States. In 1977 there were 1.16 million acres of citrus producing 14.3 million tons with a value of \$1.6 billion (1,2). Citrus as used in this study consists of oranges, grapefruit, lemons, and "other" citrus. Florida produces 73 percent of the total U.S. citrus production. California/Arizona follow with 22 percent and Texas accounts for the remaining 5 percent. Florida is the largest producer of oranges with 78 percent and the largest producer of grapefruit with 75 percent. California/Arizona however, produce the majority of lemons with 72 percent of total U.S. production (1).

California/Arizona supply a majority of the fresh market citrus with 49 percent followed by Florida and Texas with 40 and 11 percent, respectively. Processors used nearly 75 percent of the total citrus crop, 83 percent of the oranges, 58 percent of the grapefruit and 39 percent of the lemons. Florida accounted for 84 percent of the citrus processed in the three regions in 1977 (1).



## Methodology and Procedure

### Population

The population that was sampled consisted of all citrus growers in California/Arizona, Texas and Florida, with the exception of areas within these States where production was sparse. Growers having less than five acres also were excluded from the survey. Personal interviews were used to collect the data. Personal interviews are more reliable and versatile than other methods.

### Sampling Procedure

A weighted segment method of area frame sampling was used in this study (3). Using this method, data were obtained for the entire citrus operation specified for any citrus producer (in one or more of the sample segments). Sample data for each producer were weighted by the proportion of total citrus acreage which lies within one or more of the sample segments. This was necessary because the probability of any one farmer being selected within a segment was not equal, i.e., growers with one operation within a segment had less of chance for selection than those with more than one operation.

A sampling rate was established based on county data from the 1974 Census of Agriculture which provided the total number of farms producing various kinds of citrus.

Sampling rates computed for each of the three regions were 0.280 for California/Arizona, 0.192 for Florida, and 0.333 for Texas. Following this, the appropriate regional rate was applied to each county. This





made each county a subset of its appropriate region. The county's area segments (segments are subsets of a county) were formed such that each would yield an average of two citrus producing farms with headquarters within the segment. For this survey, headquarters were defined as the residence of the citrus operator (4).

Enumerators developed a sketch of each area segment to which they were assigned. Numbers were assigned to each grower in order to identify his one or more citrus operations within the respective segment. If three or less operations existed within a segment, all were interviewed. For those segments with four or more operations, a random numbers table was used to select the sample of growers to be interviewed.

A total of 3,500 interviews was desired. To obtain these numbers 4,100 growers were to be interviewed. The additional 600 producers were necessary in order to allow for non-response and unpredictable circumstances in the data collection. However, only 2,481 growers were finally interviewed. This occurred because the original estimate of the number of citrus growers from the 1974 Census of Agriculture changed significantly due to abandoned citrus acreage. The majority of this acreage was planted in more profitable crops such as avacadoes and pistachios or lost to urban and industrial development. By region, the breakdown is as follows:

	<u>Desired</u>		<u>Actual</u>
Texas	500	Texas	220
Florida	1,500	Florida	1,061
California/ Arizona	1,500 --	California/ Arizona	1,200 --
Total	3,500	Total	2,481



## Summary of Results

Citrus growers used an estimated 38.4 million pounds of pesticides (active ingredient, a.i.) in 1977 (Table 1). Of this U.S. total, fungicides accounted for 5.2 million pounds (14 percent), insecticides 27.8 million pounds (72 percent), and herbicides 5.5 million pounds (14 percent). There were approximately 8.2 million acre treatments in the three citrus producing regions of Florida, Texas, and California/Arizona.

On a regional basis, Florida growers used approximately 32.5 million pounds of pesticides on citrus in 1977. Specifically, these growers used 4.1 million pounds (a.i.) of fungicides in 1.5 million acre treatments. This represented 79 percent of the total quantity of fungicides applied by citrus producers. Insecticides accounted for this region's largest pesticide use at 25 million pounds (90 percent of all insecticides) applied in 2.5 million acre treatments. Herbicide use on Florida citrus was 3.4 million pounds (57 percent of all herbicides) applied in 1.8 million acre treatments.

Texas has the smallest quantity of citrus and also accounts for the smallest proportion of total pesticides used on citrus. Texas used 278,000 pounds of fungicides (5 percent of all fungicides) in 80,000 acre treatments. The total quantity of insecticides applied was 1.2 million pounds (4 percent of all insecticides) applied in 374,000 acre treatments. Finally, there were 255,000 acre treatments of herbicides in Texas applying 410,500 pounds active ingredient (8 percent of all herbicides).

The region of California/Arizona is the second largest user of pesticides on citrus. Citrus growers in this region applied 262,000 acre





treatments using 810,000 pounds (a.i.) of fungicides in 1977 representing 13 percent of total quantity of fungicides used in citrus production.

There were 708,000 acre treatments of insecticides applying 1.7 million pounds (a.i.) which is 6 percent of total insecticides used by U.S.

citrus growers in 1977. The total quantity of herbicides applied was 1.7 million pounds (36 percent of all herbicides) in .7 million acre treatments.



Table 1. Total acre treatments and pounds of active ingredient used on citrus by pesticide category, region and U.S. 1977.

Pesticide	Region	Acre treatments		Pounds active ingredient	
		Total	Percent	Total	Percent
		<u>1,000</u>		<u>1,000</u>	
Fungicides	Florida	1,485.2	81	4,070.0	79
	Texas	79.9	5	278.0	5
	California/ Arizona	261.9	14	810.0	16
	U.S.	1,827.0		5,158.0	
Insecticides	Florida	2,499.3	70	24,908.4	90
	Texas	373.7	10	1,184.5	4
	California/ Arizona	708.4	20	1,682.1	6
	U.S.	3,581.4		27,775.0	
Herbicides	Florida	1,823.0	66	3,436.4	62
	Texas	255.1	9	410.5	8
	California/ Arizona	684.4	25	1,667.9	30
	U.S.	2,762.5		5,514.8	
U.S. Total		8,170.9		38,447.8	

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.





California/Arizona

Nearly all the fungicides used by California/Arizona citrus growers in 1977 were comprised of copper compounds, specifically, 87 percent of the total quantity applied and 90 percent of total acre treatments (Table 2). Approximately two-thirds of total acre treatments were applied by the citrus producers with ground equipment (Table 3).

Dimethoate and sulfur constituted the largest percentage of insecticides with 46 percent of the total quantity and 36 percent of total acre treatments. Methidathion use also was fairly significant with 232,000 pounds (a.i.) or 14 percent, while 98,000 acre treatments of this insecticide resulted in 14 percent of total acre treatments (Table 4). Methods of application appear to be evenly distributed between the citrus growers and custom applicators, both of whom applied the insecticides with ground based equipment (Table 5).

Diuron, simazine, bromocil and DNBP accounted for 91 percent of the total quantity of herbicides and 87 percent of total acre treatments (Table 6). DNBP accounted for 650,000 pounds (a.i.) or roughly 40 percent of the total quantity. This represented 21 percent of total acre treatments. Herbicides in California/Arizona were either applied in a band or were broadcast and generally applied by the citrus growers (Table 7).



Table 2. Fungicides used on California/Arizona citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Fungicides	:	:	:	Pounds active ingredient		
	:	:	:	:	:	:
	:Treated :acres <u>a/</u>	:Acre :treatment <u>b/</u>	:	: Total	: Per : acre <u>c/</u>	: Per : treatment <u>c/</u>
Benomyl	521	791		625	1.20	0.79
Copper compounds	226,334	236,208		704,802	3.11	2.98
Lime	15,375	15,375		94,496	6.15	6.15
Lime sulfur	3,077	3,077		5,715	1.86	1.86
Other	5,407	6,426		4,317	0.82	0.69
Total	<u>d/</u>	261,877		809,955	<u>d/</u>	3.09
Petroleum	3,077	3,077		2,881 <u>e/</u>	0.88 <u>e/</u>	0.88 <u>e/</u>

a/ Treated acres: Acres receiving pesticides regardless of number of applications.

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Rates may vary from State recommendations because of spot or band applications and the fact that materials applied in combination are listed as separate active ingredients.

d/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

e/ Petroleum is in gallons.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.





Table 3. Method of application for fungicides used on California/  
Arizona citrus, 1977. a/

Fungicides	Who applied		How applied	
	Self	Custom	Aerial	Ground
	<u>Percent</u>		<u>Percent</u>	
Benomyl	100	-	-	100
Copper compounds	32	68	8	92
Lime	66	34	-	100
Lime sulfur	2	98	-	100
Other	87	13	-	100
Petroleum	7	93	-	100

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource  
Economics Division, ESS, USDA.



Table 4. Insecticides used on California/Arizona citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Insecticides	:	:	:	Pounds active ingredient		
	:	:	:	:	:	:
	:Treated : Acre b/ : :acres a/ : treatments : Total : acre c/ : Per : : : : : : treatment c/					
Azinphos-methyl	16,945	17,171	25,780	1.52	1.50	
Biothion	1,897	1,970	521	.27	.26	
Carbaryl	21,212	22,240	73,491	3.46	3.30	
Chlordane	915	1,066	10,971	1.20	1.03	
Chlorobenzilate	22,173	27,390	51,210	2.31	1.87	
Cyhexatin	4,510	4,603	6,731	1.49	1.46	
Diazinon	2,331	2,331	5,893	2.53	2.53	
Dicofol	34,817	37,852	82,586	2.37	2.18	
Dimethoate	221,844	245,196	465,119	2.10	1.90	
Dioxathion	6,749	7,168	10,419	1.54	1.45	
Ethion	3,269	3,269	13,253	4.06	4.06	
Fenbutatin-oxide	21,656	24,951	34,495	1.59	1.38	
Formatenate HCL	4,024	4,160	3,697	.92	.89	
Malathion	12,334	13,254	17,720	1.44	1.34	
Metaldehyde	4,253	13,694	16,464	3.96	1.23	
Methidathion	97,727	98,139	232,559	2.38	2.37	
Methiocarb	1,540	2,409	2,945	1.91	1.22	
Methomyl	38,229	41,170	26,775	.70	.65	
Morestan	13,677	13,677	14,137	1.03	1.03	
Naled	3,160	7,282	1,692	.53	.23	
Parathion	72,361	76,451	175,639	2.43	2.30	
Propargite	7,391	7,391	12,507	1.69	1.69	
Rotenone	3,237	3,797	1,934	.61	.52	
Ryania	14,239	14,329	68,104	4.78	4.75	
Sabadilla	1,209	2,048	8,144	6.74	3.98	
Sulfur	7,365	7,365	318,275	43.21	43.21	
Other	8,088	8,088	1,071	2.84	2.84	
Total	d/	708,361	1,682,132	d/	2.37	
Petroleum	65,475	81,894	1,067,688 e/	16.31 e/	13.04 e/	

a/ Treated acres: Acres receiving pesticides regardless of number of applications.

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Rates may vary from State recommendations because of spot or band applications and the fact that materials applied in combination are listed as separate active ingredients.

d/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

e/ Petroleum is in gallons.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 5. Method of application for insecticides used on California/  
Arizona citrus, 1977. a/

Insecticides	Who applied		How applied	
	Self	Custom	Aerial	Ground
	Percent	Percent	Percent	Percent
Azinphos-methyl	43	57	27	73
Biothion	13	87	-	100
Carbaryl	26	74	7	93
Chlordane	94	6	-	100
Chlorobenzilate	23	77	6	94
Cyhexatin	18	82	-	100
Diazinon	6	94	98	2
Dicofol	38	62	9	91
Dimethoate	50	50	26	74
Dioxathion	37	63	4	96
Ethion	81	19	-	100
Fenbutatin-oxide	19	81	-	100
Formetanate HCL	64	36	-	100
Malathion	44	56	8	92
Metaldehyde	77	23	-	100
Methidathion	28	72	3	97
Methiocarb	100	-	-	100
Methomyl	31	69	17	83
Morestan	25	75	-	100
Naled	20	80	5	95
Parathion	43	57	8	92
Propargite	13	87	-	100
Rotenone	35	65	-	100
Ryania	10	90	44	56
Sabadilla	3	97	-	100
Sulfur	50	50	15	85
Other	100	-	-	100
Petroleum	40	60	4	96

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource  
Economics Division, ESS, USDA.





Table 6. Herbicides used on California/Arizona citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Herbicides	:	:	:	Pounds active ingredient	
	:	:	:	:	:
	Treated	Acre		Per	Per
	acres <u>a/</u>	treatments <u>b/</u>	Total	acre <u>c/</u>	treatment <u>c/</u>
	:	:	:	:	:
2,4-D	10,858	11,774	9,736	.90	.83
Aminotriazole	661	840	2,267	3.43	2.70
Bromocil	84,068	94,576	90,581	1.08	.96
Cacodylic acid	2,904	3,930	7,778	2.68	1.98
Dalapon	1,900	2,750	4,192	2.20	1.52
Diuron	184,207	197,196	307,196	1.67	1.56
DNBP	42,667	142,940	653,165	15.31	4.57
EPTC	569	1,008	2,484	4.36	2.46
Glyphosate	16,421	26,433	65,016	3.96	2.46
Napropamide	3,573	3,573	8,932	2.50	2.50
Paraquat	20,251	35,439	24,195	1.19	.68
Simazine	145,206	157,977	485,565	3.34	3.07
Other	3,067	5,983	6,031	1.97	1.01
Total	<u>d/</u>	684,419	1,667,862	<u>d/</u>	2.43
Petroleum	64,027	104,965	474,387 <u>e/</u>	7.41 <u>e/</u>	4.52 <u>e/</u>

a/ Treated acres: Acres receiving pesticides regardless of number of applications.

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Rates may vary from State recommendations because of spot or band applications and the fact that materials applied in combination are listed as separate active ingredients.

d/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

e/ Petroleum is in gallons.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 7. Method of application for herbicides used on California/Arizona citrus, 1977. a/

Herbicides	Who applied		How applied		
	Self	Custom	Band	Broadcast	Irrigation
	Percent	Percent	Percent	Percent	Percent
2,4-D	73	27	58	38	4
Aminotriazole	100	-	58	42	-
Bromocil	76	24	13	87	-
Cacodylic acid	60	40	52	48	-
Dalapon	100	-	36	64	-
Diuron	81	19	11	89	-
DNBP	98	2	91	9	-
EPTC	100	-	-	13	87
Glyphosate	82	18	48	52	-
Napropamide	100	-	-	100	-
Paraquat	92	8	41	59	-
Simazine	94	6	20	80	-
Other	-	-	-	-	-
Petroleum	90	10	38	62	-

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



## Texas

Texas citrus growers used 278,000 pounds (a.i.) of fungicides in the 80,000 acre treatments for 1977 (Table 8). Copper compounds and zineb accounted for 79 percent of the total quantity of fungicides and 96 percent of acre treatments. These were generally applied by the citrus growers with ground equipment (Table 9).

Insecticide use in Texas totaled 1.2 million pounds (a.i.) of which chlorobenzilate and sulfur represented 63 percent of the total (Table 10). However, these two insecticides were used in only 167,000 acre treatments (46 percent) due primarily to high treatment rates for sulfur. Nearly all the insecticides were applied with ground based equipment by either the growers themselves or by custom applicators (Table 11).

For herbicides, both total quantities applied and total acre treatments were fairly evenly distributed among bromocil, diuron, MSMA and simazine (Table 12). These four herbicides comprised 87 percent of the quantity applied and 73 percent of total acre treatments. Method of application was generally broadcast and applied by either the citrus owners or the custom applicators (Table 13).





Table 8. Fungicides used on Texas citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Fungicides	:	:	:	Pounds active ingredient		
	:	:	:	:	:	:
	: Treated	: Acre <u>b/</u>	:	:	: Per	: Per
	: acres <u>a/</u>	: treatments	:	: Total	: acre	: treatment
	:	:	:	:	:	:
Captafol	353	353		353	1.00	1.00
Copper compounds	36,175	56,225		145,274	4.01	2.58
Sulfur	359	359		17,058	47.50	47.50
Zineb	13,180	22,332		75,340	5.71	3.37
Total	<u>c/</u>	79,926		278,029	<u>c/</u>	3.48
Petroleum	455	571		2,948 <u>d/</u>	6.63 <u>d/</u>	5.17 <u>d/</u>

a/ Treated acres: Acres receiving pesticides regardless of number of applications.

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

d/ Petroleum is in gallons.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 9. Method of application for fungicides used on Texas citrus, 1977. a/

Fungicides	Who applied		How applied	
	Self	Custom	Aerial	Ground
	Percent	Percent	Percent	Percent
Captafol	-	100	-	100
Copper compounds	65	35	-	100
Sulfur	100	-	-	100
Zineb	70	30	-	100
Other	9	91	-	100
Petroleum	100	--	-	100

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 10. Insecticides used on Texas citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Insecticides	Treated acres <u>a/</u>	Acre treatments <u>b/</u>	Pounds active ingredient		
			Total	Per acre <u>c/</u>	Per treatment <u>c/</u>
Azinphos-methyl	14,748	20,234	33,243	2.25	1.64
Carbaryl	2,078	2,673	11,109	5.35	4.16
Carbophenothion	27,855	36,022	116,695	4.19	3.24
Chlorobenzilate	64,134	146,141	267,101	4.17	1.83
Dicofol	36,271	48,405	133,145	3.67	2.75
Dimethoate	102	102	136	1.33	1.33
Ethion	13,166	19,883	48,613	3.70	2.45
Fenbutatin-oxide	4,470	4,470	3,105	.70	.70
Methidathion	47,141	73,586	90,284	1.92	1.23
Sulfur	6,414	21,082	479,146	74.71	22.73
Other	629	1,063	1,925	3.06	1.81
Total	<u>d/</u>	373,661	1,184,502	<u>d/</u>	3.17
Petroleum	54,964	89,806	550,452 <u>e/</u>	10.31 <u>e/</u>	6.31 <u>e/</u>

a/ Treated acres: Acres receiving pesticides regardless of number of applications.

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Rates may vary from State recommendations because of spot or ban applications and the fact that materials applied in combination are listed as separate active ingredients.

d/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

e/ Petroleum is in gallons.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.





Table 11. Method of application for insecticides used on Texas citrus, 1977. a/

Insecticides	Who applied		How applied	
	Self	Custom	Aerial	Ground
	Percent	Percent	Percent	Percent
Azinphos-methyl	55	45	-	100
Carbaryl	72	28	-	100
Carbophenothion	36	64	7	93
Chlorobenzilate	45	55	-	100
Dicofol	38	62	-	100
Dimethoate	100	-	-	100
Ethion	53	47	-	100
Fenbutatin-oxide	62	38	-	100
Methidathion	41	59	-	100
Sulfur	42	58	49	51
Other	42	58	-	100
Petroleum	40	60	-	100

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 12. Herbicides used on Texas citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Herbicides	:	:	:	Pounds active ingredients	
	: Treated	: Acre <u>b/</u>	:	: Per	: Per
	: acres <u>a/</u>	: treatments	: Total	: acre <u>c/</u>	: treatment <u>c/</u>
	:	:	:	:	:
Ametryne	14,230	25,162	41,139	2.90	1.64
Bromocil	47,667	74,846	85,645	1.79	1.14
Cacodylic acid	2,031	2,031	2,646	1.30	1.30
Dalapon	151	259	638	4.23	2.47
Diuron	41,914	65,472	89,722	2.14	1.37
DSMA	854	1,698	2,972	3.48	1.75
Glyphosate	2,500	3,816	2,163	.87	.57
MSMA	23,196	36,338	117,193	5.06	3.23
Naptalam	219	437	873	4.00	2.00
Paraquat	4,482	4,827	1,248	.28	.26
Simazine	25,190	39,303	65,253	2.59	1.66
Trifluralin	573	915	981	1.71	1.07
Total	<u>d/</u>	255,104	410,473	<u>d/</u>	1.61

a/ Treated acres: Acres receiving pesticides regardless of number of applications.

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Rates may vary from State recommendations because of spot or ban applications and the fact that materials applied in combination are listed as separate active ingredients.

d/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 13. Method of application for herbicides used on Texas citrus, 1977. a/

Herbicides	Who applied		How applied	
	Self	Custom	Band	Broadcast
-----Percent-----				
Ametryne	23	77	5	95
Bromocil	37	63	21	79
Cacodylic acid	23	77	74	26
Dalapon	100	-	10	90
Diuron	32	68	18	82
DSMA	86	14	27	73
Glyphosate	44	56	76	24
MSMA	49	51	40	60
Naptalam	100	-	-	100
Paraquat	80	20	45	55
Simazine	30	70	19	81
Trifluralin	95	5	6	94

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.





## Florida

Florida growers applied over 4 million pounds of fungicides (a.i.) in 1977 in nearly 1.5 million acre treatments (Table 14). The majority of these were applied by growers with ground based equipment (Table 15). Copper compounds accounted for 2.9 million pounds or 70 percent of the total quantity of fungicides used by Florida citrus growers.

Four insecticides (chlorobenzilate, ethion, dicofol and sulfur) represented 97 percent of the total quantity and 91 percent of the total acre treatments in 1977 (Table 16). Sulfur stood out as the insecticide with greatest use accounting for 86 percent (21.4 million lbs. a.i.) of the nearly 25 million pounds applied to citrus, however, it only accounted for 18 percent of total acre treatments. Conversely, chlorobenzilate represented 44 percent of total acre treatments yet only 5 percent of total quantity of insecticide. This is because chlorobenzilate is applied at a rate of 2 pounds a.i. per acre per season compared to 65 pounds per acre per season for sulfur. Nearly all insecticides were applied by the citrus owner using ground based equipment (Table 17).

Four herbicides bromocil, diuron, paraquat and terbacil accounted for 3.1 million pounds a.i. (90 percent) and were applied in 1.7 million acre treatments (94 percent) (Table 18). Unlike fungicides and insecticides where a single material accounted for a majority of the quantity applied and acre treatments, two herbicides bromocil and diuron stand out. Florida herbicides were generally applied as a band application by the citrus growers themselves.



Table 14. Fungicides used on Florida citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Fungicides	:	:	:	Pounds active ingredient		
	:	:	:	:	:	:
	Treated	Acre <u>b/</u>		Per	Per	
	acres <u>a/</u>	treatments	Total	acre	treatment	
	:	:	:	:	:	:
Benomyl	471,418	550,934	455,799	.97	.83	
Captafol	59,103	60,307	384,949	6.51	6.38	
Captan	9,988	10,426	38,031	3.81	3.65	
Copper compounds	626,211	791,785	2,857,575	3.73	2.95	
Ferbam	4,470	4,536	18,408	4.12	4.06	
Maneb	201	401	160	.80	.40	
Zineb	59,494	61,679	302,243	5.08	4.90	
Other	5,084	5,084	12,693	2.63	2.63	
Total	<u>c/</u>	1,485,152	4,069,858	<u>c/</u>	2.74	
Petroleum	122,391	137,715	836,229 <u>d/</u>	6.83 <u>d/</u>	6.07 <u>d/</u>	

a/ Treated acres: Acres receiving pesticides regardless of number of applications.

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

d/ Petroleum is in gallons.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 15. Method of application for fungicides used on Florida citrus, 1977. a/

Fungicides	Who applied		How applied	
	Self	Custom	Aerial	Ground
	Percent		Percent	
Benomyl	65	35	23	77
Captafol	51	49	45	55
Captan	100	-	-	100
Copper compounds	87	13	7	93
Ferbam	74	26	-	100
Maneb	100	-	-	100
Zineb	77	23	2	98
Other	96	4	4	96
Petroleum	71	29	12	88

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.





Table 16. Insecticides used on Florida citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Insecticides	Treated acres <u>a/</u>	Acre <u>b/</u> treatments	Pounds active ingredient		
			Total	Per acre <u>c/</u>	Per treatment <u>c/</u>
Acephate	281	1,123	281	1.00	.25
Azinphos-methyl	7,037	17,115	27,706	3.94	1.62
Carbaryl	1,780	2,838	3,018	1.69	1.06
Carbophenothion	84,184	119,606	437,933	5.20	3.66
Chlordane	1,864	1,883	7,475	3.97	3.93
Chlorobenzilate	668,417	1,114,028	1,361,114	2.01	1.22
Cyhexatin	2,206	2,206	1,605	.73	.73
Diazinon	3,510	4,371	11,435	3.25	2.61
Dicofol	157,861	173,498	367,066	2.33	2.12
Dioxathion	11,176	11,176	27,480	2.46	2.46
Ethion	484,568	557,488	1,150,266	2.37	2.06
Methidathion	8,491	9,483	12,999	1.53	1.37
Parathion	1,131	1,131	1,131	1.00	1.00
Propargite	13,195	18,771	26,658	2.02	1.42
Sulfur	328,046	449,876	21,440,733	65.36	47.66
Other	6,311	14,676	31,512	5.00	2.15
Total	<u>d/</u>	2,499,269	24,908,412	<u>d/</u>	9.97
Petroleum	506,496	768,671	4,144,771 <u>e/</u>	8.18 <u>e/</u>	5.39 <u>e/</u>

a/ Treated acres: Acres receiving pesticides regardless of number of applications.

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Rates may vary from State recommendations because of spot or band applications and the fact that materials applied in combination are listed as separate active ingredients.

d/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

e/ Petroleum is in gallons.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 17. Method of application for insecticides used on Florida citrus, 1977. a/

Insecticides	Who applied		How applied	
	Self	Custom	Aerial	Ground
	Percent	Percent	Percent	Percent
Acephate	-	-	-	-
Azinphos-methyl	100	-	-	100
Carbaryl	100	-	-	100
Carbophenothion	92	8	3	97
Chlordane	17	83	8	92
Chlorobenzilate	56	44	35	65
Cyhexatin	55	45	-	100
Diazinon	73	27	-	100
Dicofol	65	35	9	91
Dioxathion	82	18	-	100
Ethion	79	21	9	91
Methidathion	75	25	-	100
Parathion	100	-	-	100
Propargite	16	84	-	100
Sulfur	75	25	15	85
Other	42	58	44	56
Petroleum	48	52	42	53

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.



Table 18. Herbicides used on Florida citrus: Treated acres, acre treatments, total quantity, pounds per acre and per treatment, 1977.

Herbicides	:	:	:	Pounds active ingredient	
				: Per	: Per
	Treated	Acre <u>b/</u>			
	acres <u>a/</u>	treatments	Total	acre	treatment
	:	:	:	:	:
2,4-D	2,457	3,109	5,046	2.05	1.62
Ametryne	3,826	3,849	13,038	3.41	3.39
Atrazine	403	403	403	1.00	1.00
Bromocil	510,348	621,541	1,111,455	2.18	1.79
Chloramben	459	459	1,838	4.00	4.00
Dalapon	4,536	5,059	13,590	3.00	2.69
Diuron	441,208	553,908	1,018,439	2.31	1.84
Glyphosate	19,005	19,130	58,025	3.05	3.03
Lithium Bromocil	117	351	148	1.26	.42
Paraquat	244,057	363,783	191,712	.79	.53
Simazine	59,884	63,806	292,297	4.88	4.58
Terbacil	94,746	184,417	721,922	7.63	3.92
Trifluralin	1,763	1,763	4,389	2.49	2.49
Other	1,391	1,391	4,067	2.92	2.92
Total	<u>c/</u>	1,822,969	3,436,369	<u>c/</u>	1.89

a/ Treated acres: Acres receiving pesticides regardless of number of applications

b/ Acre treatments: Derived by multiplying treated acres times number of applications.

c/ Treated acres (col. 1) and pounds a.i. per acre (col. 4) cannot be summed because these acres are not mutually exclusive, therefore summing them would result in double counting.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.





Table 19. Method of application for herbicides used on Florida citrus, 1977. a/

	Who applied		How applied		
Herbicides	Self	Custom	Band	Broadcast	Irrigation
	Percent		Percent		
2,4-D	100	-	100	-	-
Ametryne	69	31	98	2	-
Atrazine	-	100	100	-	-
Bromocil	90	10	90	2	8
Chloramben	100	-	-	-	100
Dalapon	97	3	94	6	-
Diuron	93	7	89	2	9
Glyphosate	87	13	100	-	-
Lithium Bromocil	100	-	-	100	-
Paraquat	89	11	97	3	-
Simazine	73	27	86	14	-
Terbacil	100	-	100	-	-
Trifluralin	66	34	82	-	18
Other	100	-	67	-	33

a/ Percentages are based on acre treatments.

Source: 1977 Citrus Pesticide Usage Survey, Natural Resource Economics Division, ESS, USDA.

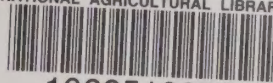


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